mates with the top surface of the via 70 and is centered on top of this surface.

Figs. 9 through 11 show further detail to demonstrate the concepts of BGA chip ball fan-out, pad relocation and the creation of common ground, power and signal pads.

Fig. 9 shows a cross section 100 of a BGA chip, five balls 101 through 105 are also shown. By using the BGA substrate 106 and the wiring 107 within the substrate 106, it is clear that ball 101 can be repositioned to location 111, ball 102 to location 112, etc. for the remaining solder bumps 103 through 105. It is clear that the separation of contact points 111 through 115 is considerably larger than the separation of the original solder bumps 101 through 105. The BGA substrate 106 is the subject of the invention, this substrate allows for spreading the distance between the contact points or balls of the BGA device to a considerable degree.

Fig. 10 shows the concept of pad relocation. BGA pad 120 can be any of the contact balls 101 through 105. By using the BGA substrate 130 and the wiring 131 that is provided within the substrate, it is clear that the BGA pads can be arranged in a different and arbitrary sequence that is required for further

circuit design or packaging. For instance contact point 101, which is on the far left side of the BGA device 100, is re-routed to location 121 which is on the second far right of the BGA substrate 130. The re-arrangements of the other BGA solder bumps can readily be learned from following the wiring 130 within the substrate 131 and by tracing from solder bump to one of the contact points 122 through 125 of the BGA substrate.

Fig. 11 shows the interconnecting of BGA device solder bumps into common power, ground or signal pads. The BGA chip 100 is again shown with five solder bumps 101 through 105. The BGA substrate 130 contains a wiring scheme that contains in this example three wiring units, one for each for the power, ground and signal bumps of the BGA device. It is clear from Fig. 11 that wire arrangement 132 connects BGA device solder bumps 101, 103 and 105 to interconnect point 138 of the BGA substrate 130. It can further be seen that BGA device solder bump 104 is connected to interconnect point 140 of the BGA substrate by means of the wire arrangement 136, while BGA device solder bump 102 is connected to interconnect point 142 of the BGA substrate by means of the wire arrangement 134. The number of pins required to interconnect the BGA device 100 is in this manner reduced from five to three. It is clear that for more BGA device solder bumps, as is the case for an actual BGA device, the

numeric effect of the indicated wiring arrangement is considerably more beneficial.

Some of the advantages of the present invention are:

1) improved speed of the IC interconnections due to the use of wider metal lines (which results in lower resistance) and thicker dielectrics between the interconnecting lines (which results in lower capacitance and reduced RC delay). The improved speed of the IC interconnections results in improved performance of High Performance IC's.

2) an inexpensive manufacturing process since there is no need for expensive equipment that is typically used in sub-micron IC fabrication; there is also no need for the extreme clean room facilities that are typically required for sub-micron manufacturing.

3) reduced packaging costs due to the elimination of the need for redundant I/O and multiple power and ground connection points that are needed in a typical IC packaging.

4) IC's of reduced size can be packaged and inter-connected with other circuit or system components without limiting the performance of the IC's.

5) since dependence on ultra-fine wiring is reduced, the use of low resistance conductor wires is facilitated.